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How to Distinguish *Amanita smithiana* from Matsutake and *Catathelasma* species

By Michael W. Beug: Chair, NAMA Toxicology Committee

A recent rash of mushroom poisonings involving liver failure in Oregon prompted Michael Beug to issue the following photos and information on distinguishing the differences between the toxic *Amanita smithiana* and edible Matsutake and *Catathelasma*.

Distinguishing the choice edible Matsutake (*Tricholoma magnivelare*) from the highly poisonous *Amanita smithiana* is best done by laying the stipe (stem) of the mushroom in the palm of your hand and then squeezing down on the stipe with your thumb, applying as much pressure as you can. *Amanita smithiana* is very firm but if you squeeze hard, the stipe will shatter. The stipe of the Matsutake is much denser and will not shatter (unless it is riddled with insect larvae and is no longer in good edible condition). There are other important differences. The flesh of Matsutake peels or shreds like string cheese. Also, the stipe of the Matsutake is widest near the gills and tapers gradually to a point while the stipe of *Amanita smithiana* tends to be bulbous and is usually widest right at ground level. The partial veil and ring of a Matsutake is membranous while the partial veil and ring of *Amanita smithiana* is powdery and readily flocculates into small pieces (often disappearing entirely). For most people the difference in odor is very distinctive. Most collections of *Amanita smithiana* have a bleach-like odor while Matsutake has a distinctive smell of old gym socks and cinnamon redhots (however, not all people can distinguish the odors). Both species taste great! *Amanita smithiana* causes delayed kidney failure and is seriously toxic

Catethelasma species (on left) are as dense and solid as Matsutake (they will not rupture when the stipe is placed in the palm of your hand and then squeezed as hard as possible with your thumb). Like Matsutake, they also have a membranous ring – versus the flocculose ring of *Amanita smithiana*. However, *Catathelasma* species have a double ring (hard to see) and have little odor. While edible, *Catathelasma* species are not nearly as delicious as the Matsutake.

UPCOMING FORAYS & OTHER EVENTS

The events page of *The Mycophile* publicizes forays and events of NAMA affiliated clubs which may be of interest to our members. If you would like to list your club's next big event, contact Dianna Smith, Editor: mycophile@namyco.org.
Include date, location, brief description, link for information, and host organization name.
To post your event on the NAMA website, contact the webmaster: webmaster@namyco.org.

JULY 27-30: Annual NEMF Sam Ristich Foray, Stratton Mountain, Stratton, Vermont. Registration will open soon. See www.nemf.org for details.

SEPTEMBER 1-4: COMA's Clark Rogerson Foray will be returning to the completely refurbished Camp Hemlocks in Hebron CT. Registration opens in June. See www.comafungi.org**.**

SEPTEMBER 7-10: NAMA Northwoods Foray at Lakewoods Resort, Lake Namakagon, Wisconsin. Registration will open soon. Consult www.namyco.org for updates. The next *Mycophile* will have further details.

Editor's Note: The winning photos of fungi in the Pictorial Category of the 2016 NAMA Photo Contest will be published in the March-April issue of *The Mycophile*

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Amanita phalloides Outbreak in California

We have a health crisis in California. Where coast live oak trees are found, 'Death Caps' are appearing by the hundreds, and people are eating them. There are currently 8-9 people in hospitals in the Bay Area. Two received liver transplants; a third person lost a liver and is on a transplant list and the others are being treated with a protocol which includes intravenous extract of milk thistle, Legalon-Sil, first used in the US in 2007 to treat patients who ate *Amanita phalloides* in Wilder Ranch State Park, north of Santa Cruz. *Amanita phalloides* are continuing to spread their range and are, due to steady rain, appearing in places we've never seen them before. We don't know why the 8-9 people ate them, but speculate that perhaps folks who had never seen them before made a very wrong assumption regarding their edibility.

If you, or anyone you know, eats wild mushrooms, please let them know that Death Caps, *Amanita phalloides*, can be found in parks from Monterey to Mendocino right now. To learn more about this deadly mushroom, follow this link: http://bayareamushrooms.org/mushroommonth/amanita_phalloides.html.

Anyone who has eaten a wild mushroom and is experiencing abdominal pain, cramping, vomiting, and diarrhea should seek medical attention immediately and call California Poison Control at 1-800-222-1222. Dogs are also at great risk.

The North American Mycological Association has a list of emergency identifiers in California who can assist with identification, and a full section of resources about mushroom poisonings. Check http://www.namyco.org/mushroom_poisoning_identifiers.php#CA.

NAMA affilliated clubs and individual members can use our resources to help. The NAMA website has an informative "poisonings" section with: detailed information about symptoms for various kinds of ingested toxins, the most visited page on the site: http://www.namyco.org/mushroom_poisoning_syndromes.php, a warning poster, http://www.namyco.org/docs/NAMA_Warning_Poster.png (large pdf file). Several parks have put up the warning poster in the past week, including San Mateo Parks Department, East Bay Regional Park District, Point Reyes National Seashore, and (hopefully) California State Parks. Kudos to these organizations for being proactive. If you know of a park with lots of Death Caps, encourage them to post a warning sign, even if mushroom collecting is not allowed.

If you know anyone who has had an unfortunate experience eating wild mushrooms this season, including pets, I encourage you to file an online poison report (https://mms.namyco.org/members/form.php?orgcode=NAMA&fid=1569949). NAMA collects these reports, and reports from its web of emergency mushroom identifiers, into an extensive database of mushroom poisonings through the decades.

There's even a page about poisonings in dogs and cats http://www.namyco.org/mushroom_poisonings_in_dogs_an.php (dogs eat lots of mushrooms; cats not so much, although it does happen) and due to the different physiology of pets, some fungi are especially toxic. Please file an online poison report for pets if you know of an incident.

Be safe. If in doubt, throw it out!

David Rust

How Fungi Can Improve the Genetic Makeup of Bacteria

Soil bacteria use the extensively branched, thread-like structures of fungi to move around and access new food sources. In a new study published in the journal *Scientific Reports*, Helmholtz Center for Environmental Research (UFZ) scientists have been able to demonstrate that these so-called fungal hyphae also form a hot spot for gene transfer between bacteria. In this way, fungi ensure high bacterial diversity in the soil – which can also be beneficial for the degradation of pollutants.

Micrograph visualizing the distribution of transconjugant bacteria (in green) along a hyphal network (in white). Transconjugant bacteria are formed by direct contact and horizontal gene transfer of differing bacteria (in red and black) invading the hyphae from the right and the left side, respectively. Credit: Berthold et al. 2016 in *Scientific Reports*

Read more at: http://phys.org/news/2016-12-fungi-genetic-makeup-bacteria.html#jCp

For bacteria, soil is difficult terrain, with dry areas and air spaces presenting insurmountable obstacles. In order to get around, they need a liquid film in which to swim. They don't demand much: the mucous layer surrounding fungal hyphae is all they need to be able to move around – and they take advantage of it. The fungal network (mycelium) also provides bacteria with an excellent infrastructure: there may be hundreds of meters of fungal hyphae winding through just one gram of soil. "In the fine liquid film surrounding the hyphae, bacteria can move with much greater speed and direction and cover more distance than in soil water without hyphae," says Tom Berthold, first author of the study and a doctoral researcher at the UFZ Department of Environmental Microbiology. "For bacteria, fungal hyphae are like a motorway which gives them fast, direct access to their food sources."

Because there is often a lot of traffic on the 'fungal highway', the bacteria may come into close contact with one another, exchanging genetic material in the process. "It's similar to the transmission of cold germs on a packed train," explains environmental microbiologist Dr. Lukas Y. Wick. "But unlike a cold, the new genes are usually an asset to the soil bacteria. They enable them to adapt better to different environmental conditions." Depending on the genes they receive through horizontal gene transfer, they may be able to adapt to new environmental conditions or access food sources which they were previously unable to exploit. For example, this might include the pollutants toluene or benzene contained in oil and gasoline, which to bacteria with the right genetic makeup are not only not harmful but actually very tasty food. So the passing on of this ability to other bacterial groups can be very advantageous in terms of the degradation of soil pollutants.

(Continued on p. 23)

The *Polyozellus* Collection at the NY Botanical Garden's Steere Herbarium

By Andrus Voitk

This report of the Steere *Polyozellus* collection constitutes the extended annotation for all the collections at this time. Electronic technology permits a more detailed record of the examination, findings and conclusions without great effort—probably a more meaningful annotation than a slip of paper bearing the name of mushroom and its annotator—especially considering that at the moment only one of six potential species has a valid name. A spreadsheet with spore measurements for all collections has been provided to NY as a supplement to this report, and may be requested from NY.

It has been my good fortune to investigate *Polyozellus multiplex* (Underw.) Murrill with a stellar group of mycologists, led by Urmas Kõljalg, one of the leading authorities of the Thelephorales group, where *Polyozellus* belongs.

Preliminary studies have revealed three phylogenetically supported stipitate *Polyozellus* morphogroups, identifiable by color: black, brown and blue. Further investigations suggest that the brown group may split into several cryptic species clades; the exact number and nature of these need not concern us for the moment, as the Steere collection has only two brown collections, both from the northeastern North American clade. The black group may also split, with a genetic difference between the fungus in northeastern North America, *Polyozellus multuplex* (Unerw.) Murrill, and that found in the Far East; both are represented at the Steere.

Polyozellus sp. by Wendy Denkins

To date the blue group seems to be monospecific, centered in northwestern North America, but on rare occasions also found in the Far East and in northeastern North America. Until the confirmation, circumscription and formal description of these clades, we can refer to them as P*olyozellus multiplex*, *Polyozellus* sp. black-orient, *Polyozellus* sp. brown and *Polyozellus* sp. blue. The analyses are not finished and this arrangement may change, but once you have separated the groups in your mind, later change to a formal binominal should not be overly difficult.

Early in our studies I had the privilege of examining Underwood's holotype of *Cantharellus multiplex* (Voitk, 2015), kept at the William and Lynda Steere Herbarium of the New York Botanical Gardens (NY), and concluded it corresponds to the black species found in the Canadian province of Newfoundland and Labrador (NL). Once we discovered that there were additional species globally, to learn their distribution we turned again to the Steere with a request to study a few additional *Polyozellus* collections. To my surprise, the response was a request to review all remaining collections labelled *P. multiplex*. This communication reports my review of these 18 additional collections (Table 1 & Fig. 1). Eleven of the 18 collections are recent additions, donated to the Steere from the Herbarium of Orson K. Miller, Jr., after his death.

The entire Steere collection contains all three stipitate *Polyozellus* color groups: seven black, (*P. multiplex*

Fig. 1. A collage of the *Polyozellus multiplex* collection at the Steere. The first box is not a *Polyozellus*, and missing from the collage are the four packets that make up the holotype, described elsewhere (Voitk 2015).

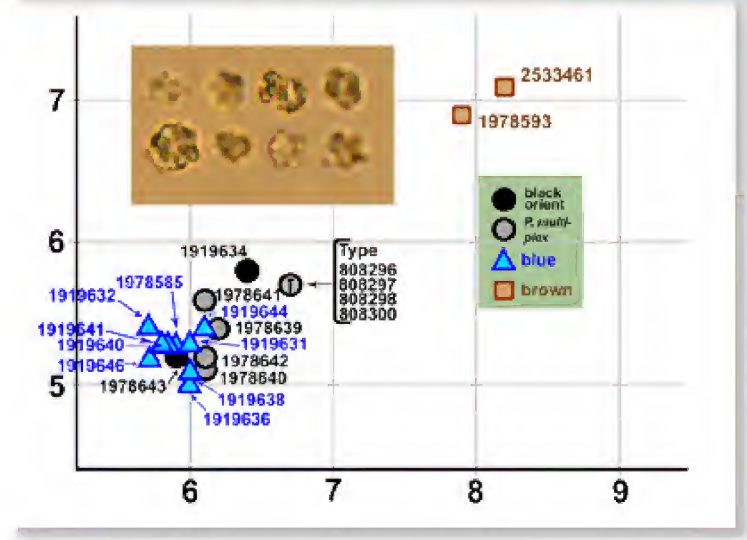

Fig. 2. Graph plotting average spore sizes of all "*Polyozellus multiplex*" collections at the Steere, color coding the tentative identifications into the currently identified species clades. Insert shows a collage of photomicrographs of 1978639, made with the new compound microscope at SWGC. The complicated and irregular shape (angular, lobed and nodular) is readily evident, even for spores not shown in optimal focus. All three brown species have readily distinguishable larger spores. The blue species has smaller spores than the two black ones, but the values are so close, with so much overlap, that this fact is not overly helpful as a field identification character.

The determinations into "groups" and "clades" are mine, and not confirmed by molecular studies; as such, they should be considered tentative. Determinations were made on the basis of spore size and geographic location.

The brown group is the easiest to separate from the other two, because it has significantly larger spores than blue or either black (Fig. 2). Both brown specimens in the Steere were collected from Seal Harbour, ME (the type region for *P. multiplex*), one in 1903 by Miss A. E. Tilton, and the other in 1912 by Fanny Mallory, and preserved in the Herbarium of the Boston Mycological Club. That collection was transferred to the Herbarium of the University of Massachusetts (MASS), where Bigelow (1978) noted these to have larger spores than seen for most *P. multiplex*. The MASS collection was transferred to NY in 1989. Spore size and site of origin makes it easy to assign these two collections to the brown clade. This species has the biggest sporocarps, and noticeably light-coloured flesh, which remains so after drying (Fig. 3). Both of these characters can be observed in these two collections, supporting the determination.

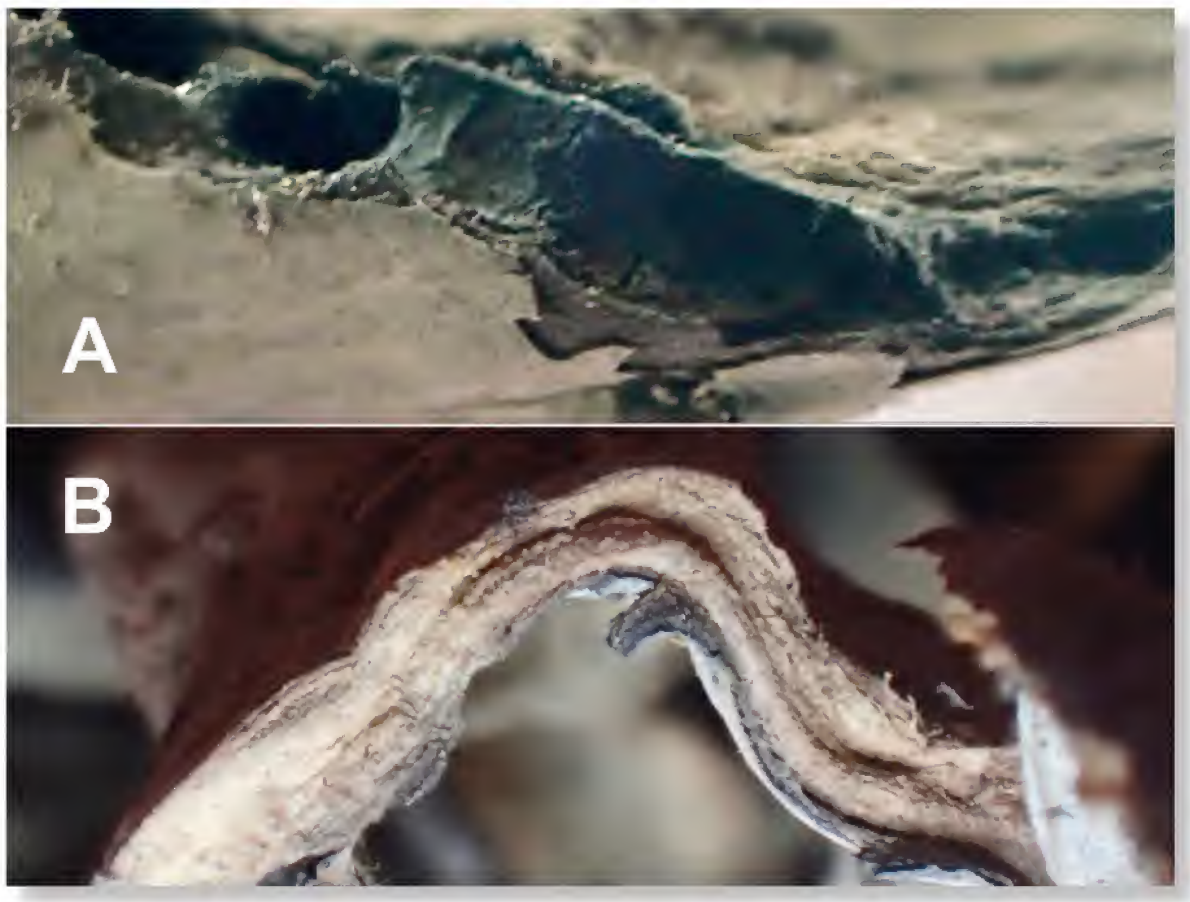

Fig. 3. Cross section of the pileus. A. Blue species, showing gray hymenium below, dark blue-black context, and a wooly pileal surface above. B. Brown species, showing gray hymenium below, attached to a black supportive layer, light colored context, and a brown pileal surface above. The light flesh color is seen in vivo, and clearly preserved in the dried state—in this case, since 1903—for this species.

Differentiating between the black and blue groups is more difficult, especially with dried material, because both have small spores. Those of the blue are smaller than those of the black (Fig. 2), but the difference is so small and the variation so great, that this is not a useful field character. Because so far our sequencing studies have not identified a black species from western North America, it seems reasonable to assign all nine small-spored western North American collections to blue. Two of the blue collections, 1919631 and 1919641, come from Colorado, just east of the Continental Divide, 191931 near Mt Evans,

and 1919641 near Breckenbridge (Fig. 4). Although the Continental Divide is generally proffered as the barrier to east-west species spread, clearly this is not the case for the blue clade, nor is it the case for many other species. Experience with reviewing the entire 13-specimens collection of the Denver Botanical Gardens (See next article), 8 from east of the Great Continental Divide, confirms that the Great Continental Divide is not a barrier to the distribution of these species. This tenet is further explored in the review of the *Polyozellus* collection of the Denver Botanical Garden.

Fig. 4. Global distribution of the Steere collection. Blue in western North America (most from Payette National Forest in Oregon and two from Colorado, east of the Great Continental Divide), *P. multiplex* from eastern North America and two black-orient from Korea—one may be blue), and the two brown collections from Maine, made by Miss A. E. Tilton in 1903 and Fanny Mallory in 1912, both from Seal Harbour in Maine, where Underwood's type of *P. multiplex* was collected by Mrs Elizabeth W. Woodworth in 1898. The genus is unknown in the Southern Hemisphere and in Europe. Although this sampling goes a long way toward providing a global picture, additional sampling is required for a complete perspective.

That leaves the remainder of the small-spored collections, five from North America and two from Korea. The North American collections contain the holotype for *P. multiplex*. The other North American collections resemble it in spore size and microscopic appearance; those for which photos exist also resemble it macroscopically. Hence, my determination for all of these is *P. multiplex*.

Our preliminary studies suggest that the black species found in the Far East may differ genetically from *P. multiplex*. Therefore, it would seem reasonable to assign both Korean small-spored species to black-orient. However, blue is also known to occur in the Far East, albeit much less frequently. Their respective prevalence increases the odds markedly in favour of both being black-orient. However, as you can see from Table 1, collections 1919634 and 1919643 seem to have different sized spores. Those of the former fall well into the range of known black group spores, but those of the latter are smaller and fit best with blue. Thus, spore size suggests that collection 1919643 may be the blue species. Arbitrarily, I have assigned it to black-orient, but it may well turn out to be blue. A mystery, unlikely to be solved without resorting to molecular studies.

In addition to the foregoing, three additional "mysteries" were encountered, possibly even solved, during this review.

Collection 1768238 is an *Albatrellus* species, placed in this group because the box is labelled "*Polyozellus multiplex*". Inside the box Orson Miller left a note, "*Polyozellus multiplex* goes with large Sept. 1976 Idaho collection. Probably *Albatrellus confluens*." Indeed, there is a large collection of *P. multiplex* from Miller's beloved Payette National Forest in Idaho from September, 5, 1976, and, no doubt it was made at the same time and place. Likely the placement of the *Albatrellus* would have been more accurate, had the note been interpreted to read, "Probably *Albatrellus confluens*. Goes [made] with the large Idaho collection of *Polyozellus multiplex* from Sept. 1976." I suggest this collection be reidentified as *Albatrellus confluens*, which seems to fit both with Miller's intent and with what is inside the box. The only *Albatrellus confluens* I have ever identified comes from a forest in NL where we have also collected *P. multiplex*.

That said, I am not sufficiently experienced with *Albatrellus*, especially a western species, to comment on the specific identification of this collection, and am happy to accept Miller's determination.

The second small mystery is an apparent duplication of a single collection. Both packets 1978640 and 1978641 come from the National Herbarium in Ottawa, Canada, and bear the same number from that institution, F6794;

both were made by W. D. Lewis in Métis Beach, QC, on July 31, 1936, and identified by L. O. Overholts. The first packet is accompanied by a letter from Irene Mounce, saying that she is sharing some material from one collection of Underwood's *Cantharellus multiplex* with various other herbaria, including NY, because the species has not been reported since its discovery and the type is located at NY. The reason for two separate packets is not clear; I treated each separately, although the record suggests they originate from the same collection.

The most interesting mystery concerns packet 1978639, which is glued to a sheet with an attractive in situ watercolour sketch (Figure 5). One of the byproducts of studying studying many collections of a small number of similar species in detail, is an eventual unavoidable familiarity with their appearance. Immediately on opening the folder with this sheet, I recognized it as an excellent representation of the brown species. This opinion was strengthened by the artist's field notes in pencil on the same sheet: "pileus … fawn colored … velvety," "meat thick whitish green inside." There are accurate drawings of the spores, which are given as "6–8 µm in diam." Because these are characters unique to the brown species, I expected the microscopic findings of the material in the packet to confirm this identification. Alas, the spores were small, characteristic *P. multiplex*!

Fig. 5 LEFT: Violetta White's watercolour of the brown species, which matches the Tilton collection. The accuracy of the depiction of this species in a young developing state is readily apparent, when compared to a recent photograph of a similar sporocarp from NL (RIGHT). The watercolour is definitely not that of *P. multiplex*, to which it is attached at the moment; likely the association occurred during the many years and travels of this collection, before settling at the Steere.

How to explain this? Even a cursory glance at the aquarelle reveals immediately that it is not a casual attempt to depict a generic concept of *Polyozellus*, but rather an attempt to capture a true representation of a very specific mushroom. The notes are equally detailed, without embellishment, setting down exactly what was observed. Both represent an accurate verbal and pictorial description of a young brown species in active growth. Compare this watercolour to a 2015 photo of a similar young specimen (Figure 5). Clearly, any thought of latitude provided by artistic license can be dismissed.

An annotation in the corner by Donald P. Rogers, attributes the aquarelle to Violetta S. E. White, who collected mushrooms from Mt Desert and deposited noteworthy specimens in NY, in some cases with a painting (White 1902). A note inside packet 1978639, signed WR, says that the material was collected in Hebron, NY, in 1905. Thus, it would seem that packet 1978639, containing fragments from a black species from Hebron, NY, was inadvertently glued to Violetta White's watercolor of a brown species from Mt Desert. The first thing to do, then, is to unfasten the Hebron packet from the drawing, and archive the former as a freestanding specimen of *P. multiplex*. This leaves the question of where Violetta White's illustration belongs.

In her publication, White states that her collecting is limited to Mt Desert, with the aim of adding a list of fungal species to an already existing list of plants from the island. In the entire group of 18 collections there are only two

from Mt Desert, the two brown collections. This fits well, because the illustration also is of the brown species, so the only thing to decide is which of the two collections it might depict. The 1912 Mallory collection is intact and shows a large cespitose cluster of mature pilei. The 1903 Tilton collection is more in keeping with a growing sporocarp, as depicted by White. Without other candidates, there remains little doubt that these were the two parts of one original collection. My suggestion is to (re)affix the Tilton collection to White's watercolor.

This overview of the Steere *Polyozellus* collection, illustrates how well kept and well documented specimens contribute to evolving new knowledge, supplying pieces in a puzzle that give meaning to the whole, long after they have been collected. The Steere collection has made a significant contribution to our larger study to circumscribe the newly discovered species in this previously monospecific genus. This review also shows the importance of accurate descriptions in word and illustration, so that inadvertent misfilings that may occur during the course of a century, travelling from herbarium to herbarium, can be corrected reliably by direct reference to available contemporaneous documentation.

My determinations require molecular studies for confirmation. I suspect that most should reflect maximal likelihood, except for the one Korean collection, 1919643, which should definitely be sequenced to identify it with certainty. The "species" clades used in this report are tentative, as the group is still undergoing active investigations.

Groupings may change with more information, but once the definitive species are described, it should not be difficult to match the present preliminary ranking with code names to the definitive species names.

Acknowledgments

I thank Ellen Bloch and the NY Botanical Garden for the loan of the specimens to study, Barbara Thiers, Roy Haling and Jason Karakehian for help with some of the detective work, Dmitry Sveshnikov and SWGC at Memorial University, Grenfell Campus, for arranging the loan and providing facilities for its examination, and, of course, my stellar collaborators in the larger project (Urmas Kõljalg, Scott Redhead, Irja Saar, Steve Trudell) for their insights, help and support.

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FUNGI IN THE NEWS

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Denver Blues

By Andrus Voitk

This report of the *Polyozellus* collection in the Sam Mitchel Fungal Herbarium has been submitted as an extended annotation for all the collections. Electronic technology permits a more detailed record of the examination, findings and conclusions without great effort—probably a more meaningful annotation than a slip of paper bearing the name of mushroom and annotator.

It has been my good fortune to investigate *Polyozellus multiplex* (Underw.) Murrill with a stellar group of mycologists, led by Urmas Kõljalg, one of the leading authorities of the Thelephorales group, where *Polyozellus* belongs. Our initial investigations suggested that in North America the genus contains three stipitate clades separable by colour: blue, brown and black. Blue seems to be common in western North America (NA), brown across the northern part of the continent, and black restricted to eastern NA with its type species, *Polyozellus multiplex* (Unerw.) Murrill. Further investigation has suggested that the black and brown clades may contain cryptic genetic species, something not directly relevant to the present report.

This neat compartmentalization was challenged when The Colorado Mycological Society posted the 2015 winning pictures of its annual photo contest on its web page. First prize in the artistic category was awarded to Wendy Dinkins for a photo of *Polyozellus multiplex* (Fig. 1). To my eye this specimen looked very much like the black species, which we hitherto thought restricted to northeastern NA. If true, this was potentially of great interest. Not only would this specimen become the furthest west the black species has ever been reported, but also it would give us an insight into impediments to distribution of these species.

Fig. 1:Wendy Dinkins' award winning photo, entitled *Polyozellus multiplex*. Characters fitting with the black species are the outwardly flared edges (not inrolled) essentially black colour, whitish margins, shiny, and seemingly hairless pileal surface with radial, irregularly raised lines. Characters of the blue species that seem to be missing are an obvious blue colour, somewhat inrolled margin edges, and felty pileal surface with zonation. Because other reasons may explain the appearance, in the absence of live material, the identification must remain a speculation only.

Most NA mushroom species complexes with different species in the east and west are said to be separated by the Great Continental Divide. Colorado straddles the Great Continental Divide so that if the Great Continental Divide forms a natural barrier to mixing of genetic material, one might expect to find the black eastern species on the Oklahoma side of the Great Continental Divide, and the blue western species on the Utah side. To date there are no publicly available *Polyozellus* sequences from the middle of the continent. In theory states like Colorado, crossed by the Great Continental Divide, might be the meeting place of the black and blue species, with the possibility of both (as well as the transcontinental brown) in one state.

Fig. 2. Satellite map from *Google Earth* showing the Great Continental Divide in orange, DBG in yellow text and the site for Wendy Dinkins' photo as a yellow star. The 12 DBG *Polyozellus* collections from Colorado are marked by cyan circes, and the two Colorado collections in NY marked with white squares. Although minor errors in placement are possible, these collections definitely come from both sides of the Great Continental Divide, showing that it is not the barrier to spread of this species. As is evident, all collections come from wooded areas, not barrens or grasslands, which suggests that the Great Plains may be the natural barrier to eastward distribution of this mycorrhizal species, as well as the westward spread of the black species, also mycorrhizal with boreal conifers.

It is relatively easy to distinguish the brown species from the others, because it has considerably larger spores than the other two. Differentiating between the black and blue species is more difficult, especially with dried material. The striking blue colour of the blue species may be very dark, approaching black, and some black ones tend to be more dark blue than black. The spores of the blue species are smaller than those of the black, but the difference is so small and the variation so great that it is more of an interesting observation than a useful identification character. The above is stated to stress that in the absence of sequencing all my identifications should be viewed as tentative.

Through Bob Shafer, president of the Colorado Mycological Society, I was able to contact Wendy Dinkins. The photo was taken in Telluride, which makes the possibility of a black species even more interesting, because Telluride is considerably west of the Great Continental Divide. Unfortunately a specimen was not collected, so that we have no voucher for examination or sequencing. But Wendy promised to look for it again this year, and collect voucher material.

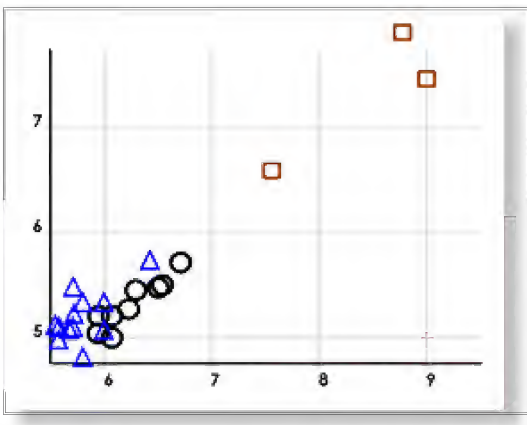
Bob Shafer also sent my query to Vera Stuckey Evenson, curator at the Sam Mitchel Herbarium at the Denver Botanical Gardens (DBG). DBG has listed its collections on MyCoPortal, making perusal easy for anybody with internet access. A quick review revealed that there were 13 specimens, 1 from New Mexico and 12 from

Colorado: 4 west of the Great Continental Divide and 8 to the east (Fig. 2). With the help of Vera Evenson, and Dmitry Sveshnikov, curator of our local herbarium (SWGC at Grenfell College of Memorial University), I was able to request a loan of the collection.

It is relatively easy to distinguish the brown species from the others, because it has considerably larger spores than the other two. Differentiating between the black and blue species is more difficult, especially with dried material. The striking blue colour of the blue species may be very dark, approaching black, and some black ones tend to be more dark blue than black. The spores of the blue species are smaller than those of the black, but the difference is so small and the variation so great that it is more of an interesting observation than a useful identification character. The above is stated to stress that in the absence of sequencing all my identifications should be viewed as tentative.

Fig. 3. Photos (both by Vera Stuckey, retrieved from MyCoPortal) of fresh specimens showing good macroscopic characters of the blue species. A. Small sporocarps showing the typically luxurious downy brown hair of the actively growing young pileus. The brown species has similar hair in youth, but markedly larger spores readily separate it from the others. B. An example of the florid blue color never seen with the other two species. Note also the felty appearance of the pileus, with a lighter edge, seen in active growth of the pileus. Larger sporocarps show the zonate appearance of the pileus, often seen with the blue species. Note that some of the proximal hairs have still retained their brown coloration.

The most interesting specimen was DBG-F-020620, which remained hard, and tiny fragments of hymenium would not soften in KOH, making a useful squash mount impossible. Possibly it had been heated a bit much in the drier. The spores recovered from its surface were a delight: a virtual spectrum of most mushroom spore forms, from elongated ascomycete spores, oblong spores with tufted ends like *Gyromitra*, double spores like *Gymnosporangium*, apiculate spores, round spores, smooth spores, reticulate and ornamented spores, etc. It left the impression of having been the first find of the morning of a long collecting day, placed in the bottom of a basket, with the spores of all the other finds landing on it in the course of the day. However, it was one of two collections with a photo showing relatively unmistakable characters of the blue species (Fig. 3). Other vouchers or photos were not equally helpful for macroscopic identification.



All specimens had small spores (Table 1). The average spore size of most collections fell just shy of that known for the black species (Fig. 4). Two straddled the overlap margin and one fell further within the range for black; however even the most extreme was within the range we had documented for the blue species, identified by DNA.

Fig. 4. Average spore size of the 13 DBG *Polyozellus* collections (blue triangles). Similar values for 9 DNA-confirmed black species from eastern North America (P. multiplex) shown for comparison (black circles). Although the average sizes differ, they are so close and the range is so wide, that identifying a single collection by spore size alone is difficult. The average sizes of three extreme brown species in our database (brown squares) are shown as well, to indicate the much more obvious spore size difference of this species from the other two. The specimen thought to be a blue species with the largest average spore size is within the range of average spore sizes for DNA-confirmed blue species in our database.

One of these collections with spores overlapping the black species in size has macroscopic features of the blue species; exsiccata of the other two look very similar (Fig. 5). On the basis of this and the low likelihood of finding a black species in this location, most likely all specimens in the DBG *Polyozellus* collection represent the blue species. Only DBG-F-019136, with its average spore size somewhat larger than that of all the others, could be suspected to represent the black species, so this identification should be confirmed with molecular studies to be certain. In addition to the collections at the DBG, I have examined two collections of *Polyozellus* from Colorado from the William and Lynda Steere Herbarium at the New York Botanical Gardens (NY). Both were collected just east of the Great Continental Divide (Fig. 2), and both have small spores, fitting best with the blue species. . Both of these were also thought to be that species (Please see previous article).

Table 1. Spore measurements

Raw data with individual measurements available from DBG on request

Collection	**SPORE SIZE**		
DBG number	**Ave (µm)**	**Range (µm)**	**Ave Q**
DBG-F-002416	5.8 x 4.8	4.8–6.7 x 4.3–5.8	1.2
DBG-F-003427	5.7 x 5.4	4.8–7.7 x 4.8–6.3	1.1
DBG-F-007097	6.0 x 5.1	4.8–6.7 x 4.3–6.3	1.2
DBG-F-014558	5.8 x 5.3	4.8–7.7 x 4.3–6.7	1.1
DBG-F-019058	5.7 x 5.1	4.8–6.7 x 4.3–5.8	1.1
DBG-F-019136	6.4 x 5.7	4.8–7.7 x 4.8–6.7	1.1
DBG-F-019647	6.0 x 5.3	4.8–7.2 x 4.8–6.3	1.1
DBG-F-020620		**no spores**	
DBG-F-020103	5.6 x 5.1	4.8–6.3 x 4.8–5.8	1.1
DBG-F-020600	5.7 x 5.2	4.8–6.3 x 4.8–6.3	1.1

If these identifications are correct, then so far the only *Polyozellus* species collected in Colorado seems to be the blue. This species is very common in northwestern North America, giving rise to the common name, blue chanterelle, in use even in regions of the continent where the blue species is rare to absent (i.e. misapplied to another, as yet undescribed, species of *Polyozellus*). Finding the blue species on both sides of the Great Continental Divide suggests that the height of land is not an impediment to the distribution of theses species. Knowing that *Polyozellus* is a mycorrhizal genus, partner to conifers of the boreal forest, suggests that the Great Plains, extending for thousands of kilometres without suitable tree partners, may provide the more logical natural barrier to transcontinental spread of such mycorrhizal species.

This overview of the DBG *Polyozellus* collection has helped to define the extent of spread of its three species,and has suggested a possible reason for such distribution patterns by potentially identifying the natural barrier to east-west species spread. This illustrates the great value of herbaria, whose collections are ready to give out significant information years, decades and even centuries after they have been collected. We have also seen the benefit of MyCoPortal, which makes it easy for all workers to review collections of interest to determine whether requesting a loan will be helpful to any pursuit they may have.

Where does this leave Wendy Dinkins's photo of a black species in Telluride? Well, without a specimen, it remains an unanswered question, so we wait for her to return to the site to collect a specimen. The only outstanding matter is to give the blue species its proper scientific name. That must wait until our studies are completed and reported, the new species formally described and named. After that it will be a small matter to replace "blue" with the new epithet for each collection. Of course, molecular studies may alter some of my identification

A temporary annotation and a spreadsheet with spore measurements have been submitted to DBG and may be considered supplemental material to this report; both may be obtained from DBG.

Fig 5. Exsiccata of the collection with the biggest average spore size (top), and the two collections with borderline average spore size (middle and lower). The middle photo in the fresh state is shown in Fig. 3 A, as an example of typical characters of the blue species. Note how similar they all look. All three show another character seen more often with the blue species than the black or brown—flattening of the hymenium with almost no perceptible gill-like wrinkles. Differentiating blue from black is difficult in vivo and often totally unreliable with exsiccata, but considering all the information together, I suspect that the odds are very much in favour of all three being the blue species.

Acknowledgments

I thank Bob Shafer for his help, Wendy Dinkins for use of her photo, Vera Evenson for help with obtaining permission for a loan of the collection, DBG and Melissa Islam, head curator at DBG, for arranging the loan, Ellen Bloch and NY for the loan of the NY specimens, Dmitry Sveshnikov, curator of herbarium SWGC at Memorial University, Grenfell Campus, for requesting both loans and providing facilities for their examination, and, of course, my stellar collaborators in the larger project (Urmas Kõljalg, Scott Redhead, Irja Saar, Steve Trudell) for their insights, help and support.

References

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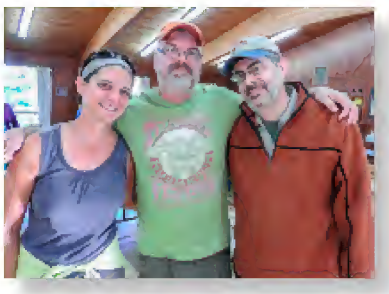
2017 Annual Foray of the North American Mycological Association

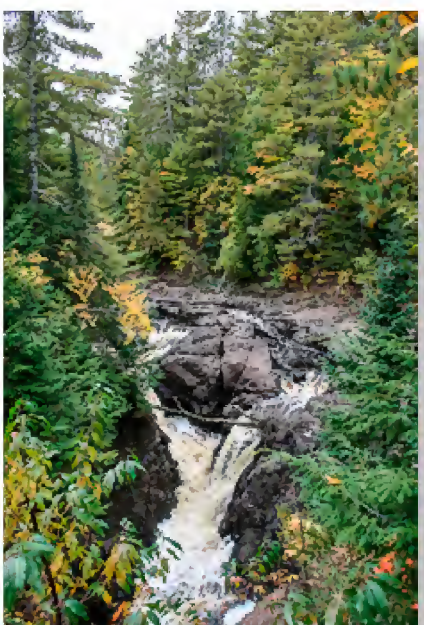
Part II. Getting There and Away
(and some additional things to do in the area afterwards)

By Britt A. Bunyard



Title: The 2017 NAMA Northwoods Foray
When: 7-10 September 2017
Where: Lakewoods Resort, Lake NAMAkagon, Wisconsin

Coordinators:
Britt A. Bunyard
Emily Stone, Naturalist, Cable Museum of Natural History, Cable, Wisconsin
Patrick Leacock, Field Museum of Natural History, Chicago



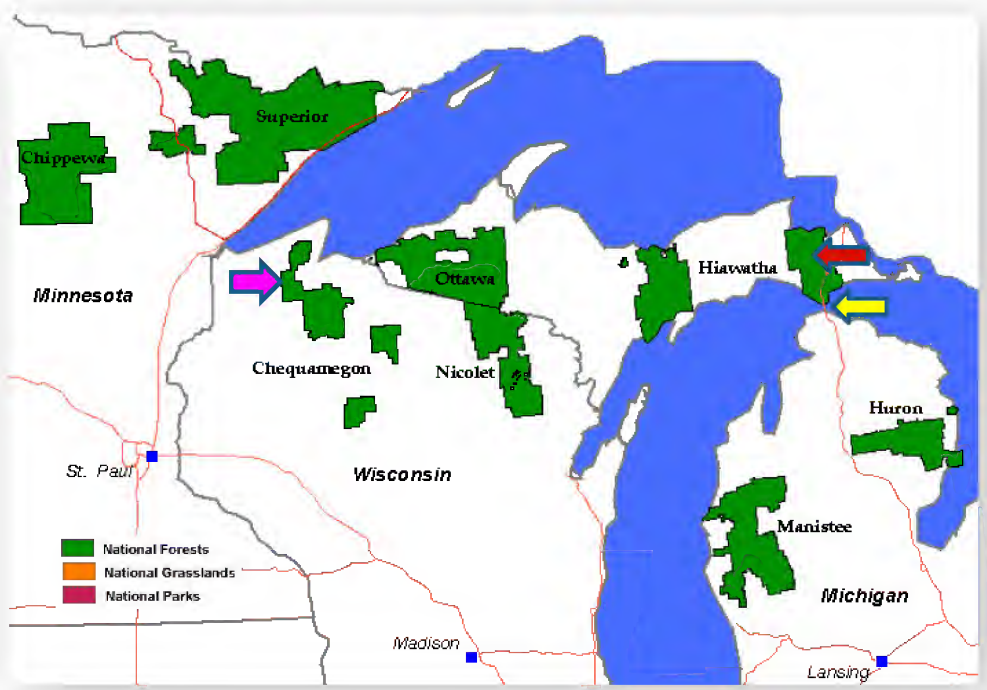
Make plans now to be in northwestern Wisconsin next September. Specifically, Bayfield County. This is my absolute favorite place in Wisconsin for both natural beauty and mushrooms, and I know you will feel the same way after next year's NAMA Foray. In the previous *Mycophile* I gave you a sneak peek of what to expect of the host site, foray sites and habitat, and some facts about Bayfield Co., Wisconsin, and the surrounding region. (It's worth repeating that although one of the largest counties in Wisconsin, Bayfield County has not one stoplight. It's mostly National Forest, and in September the forests are carpeted with mushrooms!)

Getting there and away…and extending your stay

Ok, you're ready to sign up. Next questions are how to get there and tips on additional things to do in the region. I'm so glad you asked! I urge you to visit and to spend more than just a few days in the area. The Northwoods offer incredible scenery (the fall color change will be underway) and is a tremendous value. If coming from the East or West Coasts, you will find it to be an absolute bargain. **How to get there**. The town of Cable, WI, is about 3 hours from Minn.-St. Paul (your cheapest bet for air tickets; air tickets to MSP from the East or West Coast typically run under $400 and possibly less than $300); 90 min from Duluth, MN (which has a much smaller airport); 6 hours to Milwaukee; 8 hours to Chicago. Note: we have plans in place for a shuttle pick up to and from the Duluth airport for NAMA attendees.

If traveling the region before or after the Foray, I can recommend many wonderful things to see and do (and feel free to email me with questions). See the map, below, to get your bearings (Cable, WI, at the pink arrow). About one hour north of Cable are the scenic Apostle Islands and National Lakeshore. You can cruise

the islands, hike or camp the parks of the National Lakeshore. Hopping on Route 2 headed east you'll soon cross into the Upper Peninsula of Michigan. The journey across the UP is a very easy drive with little traffic; there are many places to camp along the way in the Ottawa National Forest. There are plenty of motel options and they're going to be more affordable than most other regions of the USA; dining out is similarly affordable. Around the midpoint of the UP, you may want to make a side trip to see the historic and beautiful Copper Peninsula or hike the scenic trails along the cliffs of Pictured Rocks National Lakeshore. (Both are well worth the trip!) On the eastern extreme of the UP is scenic Tahquamenon Falls State Park (famous haunt of mycologist A. H. Smith; see red arrow on map), Mackinac Island—great for a day trip!—and the amazing Mackinac Bridge to lower Michigan (see yellow arrow on map). The "Big Mac" Bridge is the fifth longest suspension bridge in the world and the longest in the Western hemisphere. The drive from Cable, WI, to the Mackinac Bridge in Michigan is easily made in a single day.



A few more teasers

Dr. Patrick Leacock, mycologist at the Field Museum in Chicago, is the Chief Mycologist of the 2017 NAMA Foray. Most of you will recognize Patrick as he oversees the NAMA Voucher Program and has been to pretty much every NAMA foray for over the past two decades. He is very familiar with operations at NAMA Forays. He's also familiar with all our collections sites in the Cable area (as we have been collecting or conducting organized forays at these same sites for several years now). Additionally, we have a really exciting lineup of mycologists from the Midwest and beyond who have committed to attend next year's Foray, serving as presenters, foray leaders, and identifiers. Plus too many other surprises to list here!

Next time: Part III and registration begins!

Make plans to come to Wisconsin in 2017!

Voucher Report for the 2016 North American Mycological Association Foray

Shenandoah Foray
Front Royal, Virginia
September 8-11, 2016

By Patrick R. Leacock, *NAMA Voucher Collection Project*, pleacock@fieldmuseum.org

Summary

The 2016 annual foray was held September 8 - 11, 2016, at the Northern Virginia 4-H Educational Center, Front Royal, Virginia. The Mycological Association of Washington DC and the New River Valley Mushroom Club hosted the foray. Chief Mycologist was Walt Sturgeon. Collecting areas included many areas of Shenandoah National Park, as well as G R Thompson State Wildlife Management Area, George Washington National Forest, and the Appalachian Trail. This was the first NAMA annual foray in Virginia.

Many thanks go to Adele Mehta, foray recorder, and the NAMA-sponsored voucher assistants: Nicolette Albright and Dillon Husbands from Purdue University, West Lafayette, Indiana (Dr. Aime); Emma Harrower and Rachel Swenie from University of Tennessee, Knoxville (Dr. Matheny); and Bruch Reed, New York Mycological Society. Special thanks to Arlene R. Bessette for recording species found in Shenandoah National Park. Big thanks to the foray team and all the volunteers who ran the collecting trips, specimen sorting, and display room. We thank the board and trustees of NAMA for their continued support of the voucher program. The NAMA specimens are accessioned into the permanent herbarium collection at the Field Museum of Natural History (F).

Molecular work is underway for many of the foray vouchers to generate DNA sequences. Stephen Russell led the work of obtaining tissue samples during the foray from most of the vouchers.

The DNA sequencing is carried out by Rytas Vilgalys and his students, Duke University. John R. Plischke III took microscope photos of most vouchers.

This species list has 344 taxa (genus, species, and varieties), comprising 61 ascomycetes (17 lichens), 279 basidiomycetes, 1 zygomycete, and 3 myxomycetes. The most diverse genera were *Lactarius* and *Lactifluus* (22), *Russula* (20), and *Amanita* (17+). Identifications were made by 25 persons including Alan E. Bessette, Walter E. Sturgeon, Arlene R. Bessette, Patrick R. Leacock, Gary H. Lincoff, Dorothy C. Smullen (lichens), Brian P. Looney, N. Jay Justice, David H. Wasilewski, Debbie L. Viess, and 15 others. There are 340 voucher collections preserved from the foray. Taxa with more than one voucher specimen are indicated "(2)". Forty-six listed names do not have voucher specimens, marked with asterisk; some were not worth preserving and some names were added after foray.

These species vouchers with images will be posted on Mushroom Observer: http://mushroomobserver.org/observer/show_user/3534 Additional information about the NAMA Voucher Collection project can be found on the NAMA website: http://www.namyco.org/voucher_collection_project.php

MycoGuide:

Mushrooms of the Midwest and America.
http://mycoguide.com

is an excellent and expanding resource for mycophiles wanting to look deeper into the relatively adolescent science of fungi. Its creator is Mycologist and Botanist Patrick R. Leacock. .

Kingdom Fungi

Ascomycota

Akanthomyces aculeatus [*on moth]* (2)

Apiosporina morbosa

Arthonia caesia

Bisporella citrina

Camarops petersii

Chlorociboria aeruginascens [Chlorosplenium]

Chlorosplenium chlora

Chromelosporium sp.

Cladonia coniocraea

Cladonia furcata (2)

Cladonia macilenta

Cladonia pleurota

Cordyceps militaris (2)

Daldinia childiae

Diatrype stigma

Flavoparmelia baltimorensis

Flavoparmelia caperata

Galiella rufa

Hymenoscyphus fructigenus

Hypocrea sp.

Hypomyces sp. [on boletes] (3)

Hypomyces chrysospermus

Hypomyces hyalinus

Hypomyces lactifluorum

Hypoxylon fragiforme

Hypoxylon fuscum

Hypoxylon rubiginosum

Isaria farinosa

Lasallia papulosa

Lecanora nothocaesiella

Leotia lubrica

Leotia viscosa

Lophodermium pinastri

Microglossum rufum

Mollisia sp. *

Myelochroa aurulenta

Nectria sp.

Orbilia sp. *

Parmelia sulcata

Peltigera evansiana

Phaeocalicium polyporaeum *

Pleurocolla compressa [Leucogloea]

Punctelia rudecta

Rhytisma sp.

Rosellinia sp.

Rosellinia subiculata *

Sarcoscypha occidentalis

Scutellinia sp.

Scutellinia cf. scutellata

Stereocaulon saxatile

Tapesia fusca *

Tatraea macrospora

Trichoderma harzianum

Trichoglossum sp. *

Umbilicaria mammulata

Xanthoparmelia plittii

Xylaria liquidambaris *

Xylaria longipes

Xylaria polymorpha

Xylaria tentaculata

unknown sp.

Basidiomycota

Agrocybe firma

Albatrellus cristatus

Amanita section Amidella

Amanita section Vaginatae (7)

Amanita sp-S01

Amanita bisporigera (2)

Amanita brunnescens

Amanita cf. ceciliae

Amanita cinereoconia

Amanita farinosa

Amanita flavoconia

Amanita fulva group (4) [also *A. amerifulva*]

Amanita lavendula (2)

Amanita longipes

Amanita muscaria

Amanita peckiana (2)

Amanita sinicoflava

Amanita subcokeri

Amanita whetstoneae (2)

Antrodia favescens

Armillaria mellea

Armillaria tabescens

Arrhenia epichysium [Omphalina]

Artomyces pyxidatus

Astraeus morganii

Aureoboletus auriporus

Aureoboletus innixus

Auricularia angiospermarum

Austroboletus gracilis *

Bjerkandera adusta

Bolbitius titubans

Boletinellus merulioides

Boletus longicurvipes

Boletus pallidoroseus

Boletus subvelutipes

Byssomerulius incarnatus

Callistosporium purpureomarginatum

Calocera cornea

Calostoma cinnabarinum

Cantharellus sp.

Cantharellus altipes

Cantharellus cinnabarinus

Cantharellus lateritius

Climacodon septentrionalis

Clitocybe adirondackensis [Singerocybe] *

Clitocybe gibba *

Clitocybe odora

Coleosporium asterum [C. solidaginis]

Coltricia montagnei

Connopus acervatus *

Coprinellus radians

Corticium roseum *

Cortinarius bolaris

Cortinarius sect. phlegmacioides (2)

Craterellus fallax

Craterellus ignicolor

Craterellus tubaeformis

Crucibulum laeve

Cyanoboletus pulverulentus [Boletus] (2)

Cyptotrama asprata *

Dacrymyces chrysospermus [D. palmatus]

Dacryopinax spathularia

Daedalea quercina (2)

Daedaleopsis confragosa

Daedaleopsis septentrionalis

Dendrothele nivosa

Ductifera pululahuana

Entoloma abortivum (2)

Entoloma murrayi

Entoloma cf. *strictius*

Entoloma strictius var. isabellinum

Fibrodontia gossypina [Hyphodontia]

Fistulina hepatica

Fomes fomentarius

Fomitopsis spraguei

Fulvifomes robiniae [Phellinus]

Fuscoporia gilva [Phellinus]

Ganoderma applanatum *

Ganoderma curtisii

Geastrum saccatum

Gerronema strombodes

Gloeoporus dichrous

Gomphus clavatus

Gymnopilus luteus

Gymnopus confluens

Gymnopus dichrous *

Gymnopus dryophilus

Gymnopus subnudus

Gymnosporangium cf. *juniperi-virginianae*

Gyroporus castaneus *

Hapalopilus nidulans [H. rutilans]

Haplotrichum cf. sp.

Hohenbuehelia mastrucata

Hohenbuehelia petaloides

Hydnellum sp.

Hydnellum spongiosipes

Hydnochaete olivacea

Hygrocybe sp.

Hygrocybe caespitosa

Hygrocybe flavescens (2)

Hygrocybe miniata

Hygrocybe nitida

Hygrophoropsis aurantiaca *

Hymenochaete rubiginosa

Hymenochaete tabacina [Hymenochaetopsis]

Hymenopellis sp. (2)

Hymenopellis furfuracea

Hymenopellis rubrobrunnescens

Hyphodontia sambuci *

Hypholoma fasciculare

Hypholoma subviride

Inocybe sp. (3)

Inocybe cf. *rimosa*

Inonotus obliquus

Irpex lacteus

Ischnoderma resinosum

Laccaria sp.

Laccaria ochropurpurea

Lactarius camphoratus *

Lactarius chelidonium

Lactarius chrysorrheus *

Lactarius croceus (2)

Lactarius griseus

Lactarius lignyotus

Lactarius luteolus

Lactarius peckii

Lactarius pubescens

Lactarius pyrogalus

Lactarius quietus var. incanus *

Lactarius cf. *speciosus* *

Lactarius subpalustris

Lactarius subpurpureus

Lactarius subvellereus var. subdistans *

Lactarius subvernalis

Lactarius theiogalus *

Lactarius uvidus

Lactifluus corrugis [Lactarius]

Lactifluus glaucescens [Lactarius] (3)

Lactifluus hygrophoroides [Lactarius] *

Lactifluus volemus [Lactarius]

Laetiporus cincinnatus

Laetiporus sulphureus

Leccinellum albellum

Leccinum scabrum (2)

Lentinellus cochleatus

Lentinellus micheneri

Lentinellus ursinus

Lentinus levis [Pleurotus]

Lentinus suavissimus (2)

Lepiota aspera

Loweomyces fractipes [Abortiporus]

Lycoperdon perlatum

Marasmius capillaris *

Marasmius nigrodiscus

Marasmius siccus

Marasmius strictipes

Marasmius sullivantii *

Megacollybia rodmani

Melanoleuca alboflavida (2)

Melanoleuca cf. *melaleuca*

Meripilus sumstinei

Mutinus elegans

Mycena sect. fragilipedes

Mycena acicula

Mycena crocea [M. luteopallens]

Mycena haematopus

Mycena inclinata

Mycena leaiana

Mycena niveipes

Mycena subcaerulea *

Mycetinis scorodonius

Mycorrhaphium adustum

Nigroporus vinosus

Omphalotus illudens

Onnia tomentosa [Inonotus]

Oxyporus populinus

Panellus stipticus

Peniophora albobadia

Peniophora cinerea

Phallus cf. *impudicus*

Phanerochaete chrysorhiza

Phleogena cf. *faginea*

Pholiota granulosa

Pholiota squarrosoides

Phylloporus rhodoxanthus

Pleurotus dryinus

Pleurotus pulmonarius

Pluteus sp. *[P. cervinus group]*

Pluteus admirabilis

Pluteus americanus

Pluteus cervinus

Pluteus longistriatus *

Pluteus pellitus

Pluteus salicinus

Polyporus alveolaris [Neofavolus] *

Polyporus badius [Picipes]

Polyporus leptocephalus [Cerioporus]

Polyporus squamosus [Cerioporus]

Porodisculus pendulus

Postia fragilis [Oligoporus, Tyromyces]

Psathyrella delineata

Pseudoboletus parasiticus

Pseudocraterellus subundulatus

Pseudoinonotus dryadeus [Inonotus]

Ramariopsis kunzei

Resupinatus applicatus *

Retiboletus ornatipes *

Rhizomarasmius pyrrhocephalus *

Rhodocollybia maculata

Rickenella fibula *

Russula amoenolens

Russula aquosa

Russula ballouii

Russula barlae

Russula brevipes var. acrior

Russula brunneola *

Russula corallina

Russula crustosa

Russula earlei

Russula eccentrica

Russula foetentula

Russula font-queri

Russula fragrantissima

Russula mariae

Russula parvovirescens

Russula rubriceps *

Russula subpunctata

Russula variata

Russula vinacea

Russula xantho

Sarcodon sp.

Sarcodontia setosa (3)

Schizophyllum commune

Scleroderma areolatum *

Scleroderma citrinum

Sebacina incrustans

Sebacina pallida [Tremellodendron]

Spongipellis pachyodon

Steccherinum sp. (3)

Steccherinum ochraceum

Stereum complicatum

Stereum gausapatum

Stereum hirsutum [S. rameale]

Stereum ostrea

Stereum striatum

Strobilomyces confusus

Suillus americanus

Suillus spraguei (3)

Tapinella atrotomentosa (3)

Terana coerulea [T. caerulea]

Tetrapyrgos nigripes *

Thelephora sp. (2)

Thelephora vialis

Trametes betulina

Trametes cinnabarina [Pycnoporus]

Trametes conchifer [Poronidulus]

Trametes gibbosa (2)

Trametes hirsuta *

Trametes suaveolens *

Trametes versicolor

Tremella mesenterica *

Trichaptum biforme

Tricholoma aestuans

Tricholomopsis rutilans

Truncospora ohiensis

Tylopilus felleus

Tylopilus rubrobrunneus

Tyromyces chioneus

Xanthoconium affine *

Xanthoconium affine var. maculosus *

Xenasmatella vaga [Phlebiella] *

Xerocomellus chrysenteron

Xeromphalina sp.

Xeromphalina kauffmanii

Xylobolus frustulatus

Zygomycota

Massospora [on cicada]

Kingdom Protozoa

Myxomycota

Ceratiomyxa fruticulosa *

Fuligo septica

Metatrichia vesparium *

Recomended Fungi Video Resources

from Patrick Leacock's MYCOGUIDE Website

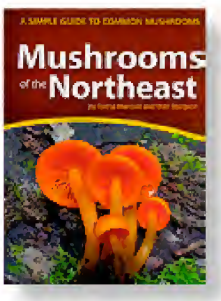
Citizen Science: Collecting Specimens: http://mycoguide.com/guide/resources/video/citsci02

Citizen Science: Photographing Mushrooms: http://mycoguide.com/guide/resources/video/citsci03

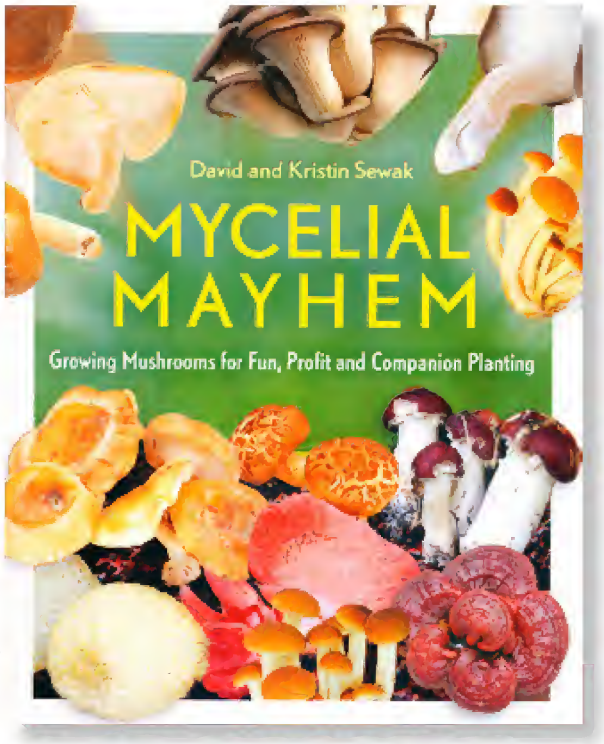
Citizen Science: Somme Woods Plot Study Introduction: http://mycoguide.com/guide/resources/video/somme01

Nature Guidebook Winner of the 2016 National Outdoor Book Award

Mushrooms of the Northeast: A Simple Guide to Common Mushrooms. By Teresa Marrone and Walt Sturgeon. Adventure Publications, Cambridge, MN. ISBN 9781591935919



Mycelial Mayhem: Growing Mushrooms for Fun, Profit, and Companion Planting



David and Kristin Sewak

New Society Publishers (www.newsociety.com), 2016

ISBN 978-0-86571-814-2 (paper; xviii+269 pages)

List price $29.95

Mushrooms, wild and otherwise, continue to increase in popularity, whether it be foraging for wild species (while being chauffeured in a Cadillac Escalade and served gourmet pastries in a recent *Sunset* magazine article), using them to dye natural fabrics, or cultivating them at home. Not surprisingly, this increased interest has led to publication of a number of books focused on mushrooms. *Mycelial Mayhem* is a recent addition to the cultivation books field, with an emphasis on growing for sale.

At their Pennsylvania farm (Berglorbeer Farma), which features prominently in the book, the Sewaks grew mushrooms and vegetables for their family's use and for sale to restaurants and at venues such as farmers' markets. They also made mushroom grow kits and logs, taught classes about mushroom growing, and collected wild mushrooms from the surrounding forest for home use and sale. They subsequently have relocated to Montana.

The book's front matter is brief, consisting of Acknowledgments, Foreword, and an introduction that explains the book's title and relates how Dave and Kristin arrived at their mushroom-focused way of life by separate paths. The main part of the book is organized in four sections. Section I (Mycelia): Why mushrooms? Mushroom basics. Section II (The Stem): Growing mushrooms; Wild collecting and purveying; Companion planting and other sustainable methods. Section III (The fruit of your labor): Umami of edible mushrooms; Nutritional benefits of mushrooms; Niche business or supplemental income; Marketing mushrooms. Section IV (Spreading the spores): Conclusion: spread your spores. The text is augmented with numerous black-and-white photos and occasional line drawings. Additional attractive color photos are grouped together in a separate section. The back matter is fairly extensive, with nearly 20 pages of examples of marketing and communications materials from the Sewaks' own business, a lengthy list of published and online resources sorted by subject, chapter-by-chapter references cited, and an index.

The text presents a wide range of material based on the Sewaks' experience and, as such, comes across as "they know what they are talking about" when they explain how they built the farm and made things work in their business, augmented with personal anecdotes. Those are the strongest parts of the book. They have what might be called a "back to the Earth" philosophy and talk a lot about sustainability, resilience, and permaculture. Some readers might find the presentation of these topics too romanticized and have a problem with claims such as "mankind has utilized mushrooms since the dawn of humanity," "mushrooms alkalize the human body," "mushrooms make all of your veggies better tasting and more nutritious," and "mushrooms have the potential to restore landscapes by soaking up pollutants." No explanation of, or basis for, these statements is provided. Similarly, a long list of medicinal benefits of mushrooms is described without acknowledging that there is still

much legitimate debate over whether or not and which of these benefits are real. Unfortunately, they refer to those who don't accept their beliefs as "naysayers."

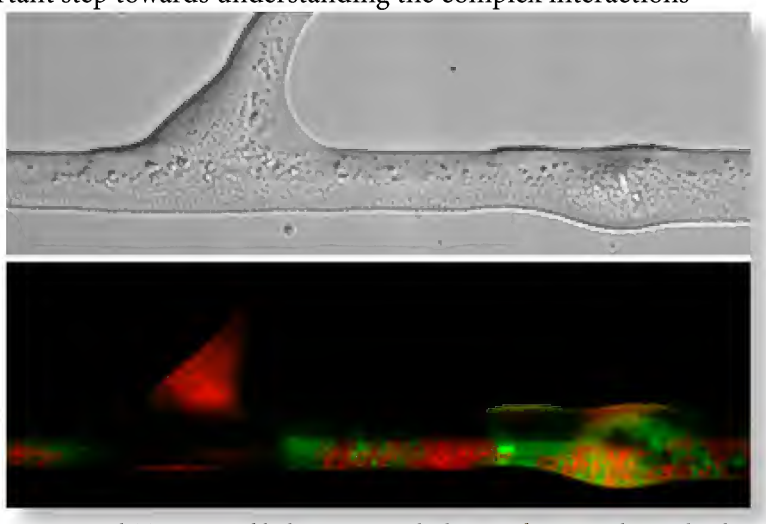
Good detailed descriptions of cultivation methods that they found successful for production of commercial quantities are given for oyster mushrooms, shiitake, and king stropharia, the latter as a companion planting in their garden. However, only one chapter of the book is devoted to actually growing mushrooms and it does not provide much of a general introduction to cultivation practices, so a neophyte cultivator would have to go elsewhere for that information. For someone trying to emulate their business, there is a lot of very useful information about starting and running such a venture, particularly their marketing suggestions and advice for preparing to sell at farmers' markets and similar venues.

In summary, *Mycelial Mayhem* provides a lot of good advice for folks who want to pattern their lives after those of the Sewaks and have a sufficiently large property, complete with abundant hardwood and conifer trees, located in an area that provides a market for sale of the mushrooms produced. However, it will be less helpful for those who are getting started with mushroom cultivation and want to operate for personal use on a smaller scale in an urban or suburban environment. These folks probably will find the how-to information in Stephen Russell's *The Essential Guide to Cultivating Mushrooms* (reviewed in the March-April 2016 issue of *The Mycophile*) or Tradd Cotter's *Organic Mushroom Farming and Mycoremediation* (reviewed in the Winter 2014 issue of *FUNGI* magazine) more suited to their purposes.

Steve Trudell

(Continued from p. 4 *"How Fungi Can Improve the Genetic Makeup of Bacteria")*

In their research, the UFZ scientists were also able to show that much greater gene transfer takes place between bacteria on the fungal highway than in a moist environment without fungal hyphae. Using computer models that calculate the frequency of gene transfer between bacteria on the hyphae, the researchers came to the same result. Wick continues: "Our study shows that fungal hyphae not only provide soil bacteria with an excellent infrastructure, but also a potential hot spot for bacterial horizontal gene transfer. This previously unknown aspect of fungus-bacteria interaction is an important step towards understanding the complex interactions between soil-dwelling microorganisms."



Upper panel: Transmitted light micrograph showing bacteria along a hypha. Lower panel: Micrograph visualising the distribution of transconjugant bacteria (in green) along the hypha as depicted in the upper panel. Credit: Berthold et al. 2016 in *Scientific Reports*

Fungi therefore may play a very important role in the highly complex soil habitat: in the spread of soil bacteria, their genetic adaptation and diversity, and ultimately also their evolution. "Just a few years ago, we were still completely unaware of this," says Wick. "It's possible that over the course of the Earth's history, bacterial diversity increased massively with the development of mycelium-forming fungi." As far as the breakdown of pollutants is concerned, the UFZ researchers conjecture that soils containing a lot of fungi are probably better equipped than soils with few fungi. This is because the fungal highway enables pollutant-degrading bacteria to reach their food faster and, with the help of gene transfer, they may even be upgraded along the way.

Tom Berthold et al. "Mycelia as a focal point for horizontal gene transfer among soil bacteria", *Scientific Reports* (2016). DOI: 10.1038/srep36390. http://phys.org/news/2016-12-fungi-genetic-makeup-bacteria.html#nRlv.

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THE MYCOPHILE

Mushroom of the Issue

Trichaptum biforme, Violet Toothed Polypore

Trichaptum biforme Photo by David Work

It often grows in thin fan-shaped tiers that sometimes completely cover the surface of standing dead hardwood trees, fallen logs and tree limbs. It is a saprotrophic white rotter. The top of the polypore is finely fuzzy bearing a thinly zoned grayish to pale tan surface with a zonate and intensely purplish margin edged in white. The hymenium consists of pores that split as the fruiting body expands aquiring the appearance of 'tooth-like' projections. When fresh, the pore surface can also assume a bright lavender color, in the region closest to the margin. Trichaptum biforme fruits from spring through autumn. The top surface is often host to *Phaeocalicium polyporeum*, the tiny 'Matchstick Fungus', a saprobic asco, which favors residing in the darker zonate lines closest to the growing edge.

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